Appendix B
Glossary

Most geophysical terms used in the manual have been defined where the terms were introduced. Additional terminology routinely used in seismic processing and well logging is presented in this glossary.

B-1. Seismic Processing Terms

The following guide to terminology is given to assist the nonspecialist in communicating with the processing geophysicist. Processing generally consists of a series of steps with frequent iterations of earlier steps. The experience of the processor is crucial to guiding the number and timing of these iterations. The list of terms given below is not necessarily in the order used in processing, and alternative jargon with similar meanings is given.

Automatic Gain Control (AGC)
A process for increasing the amplitude of a trace with time, thus making all events on the trace appear to be of approximately the same amplitude. Note that this process will expand the amplitudes *even if no data are present*. Various window lengths are used; the appearance of the data may be greatly affected by the window used in the calculation.

Brute stack
A common midpoint stack with only preliminary static corrections (often none) and preliminary normal-moveout corrections (often constant velocity). This stack is often done by field computers to verify the existence of actual reflections.

Deconvolution
A data processing technique applied to seismic reflection data for the purpose of improving the recognizability and resolution of reflected events. The process reverses the effect of linear filtering processes (convolution) that have been applied to the data by recording instruments or other processes.

Depth section
A cross section to which a velocity function has been applied, thus converting arrival times of reflections to depths.

F-K filtering
As frequency filtering removes components of a signal with particular time variations (low-frequency cut, etc.), F-K filtering removes components of seismic records with particular variations in both time (frequency) and space (K or wave number). As an example, ground roll will often be of low frequency and, due to the low velocity, have short wavelengths (high wave number). Thus, a low-frequency, high-wave number cut filter will attenuate ground roll.

Migration
A rearrangement of interpreted seismic data so that reflections are restored to their true location on a two-dimensional cross section. Apparent dips are restored to true dips to the extent possible.

Muting
Change in the amplitude of all or part of a trace before additional processing. Noisy or clearly erroneous traces are given zero amplitude. Data before the first break and the known refraction arrivals are also often reduced to zero amplitude.

Normal moveout corrections
Time shift corrections to reflection arrivals because of variation in shotpoint-to-geophone distance (offset). The amount of shift depends on 1) the length of the raypath from shot to reflection point to receiver, and 2) the velocity of the material traversed. Deeper reflections are corrected using velocities indicative of the deeper section.

Sort
Data in shot record form are sorted for display as common offset records, common shot records, common receiver records, or common depth point records.

Statics
Time shift corrections to individual traces to compensate for the effects of variations in elevation, surface layer thickness or velocity, or datum references.

Velocity panels
A set of stacked test sections with a progression of assumed normal-moveout velocities applied. A powerful method for determining velocities if distinct reflection events are present, as the reflections will be coherent where the velocities are correct and be degraded in appearance at higher or lower NMO velocities.

B-2. Common Well-logging Terms

Acoustic log
Also called sonic log; a record of changes in the character of sound waves as they are transmitted through liquid-filled rock; a record of the transit time (t) is the most

common; amplitude and the full acoustic-wave form also are recorded.

Acoustic televiewer log
A record of the amplitude of high-frequency acoustic pulses reflected by the borehole wall; provides location and orientation of bedding, fractures, and cavities.

Acoustic wave
A sound wave transmitted through material by elastic deformation.

Activation log
Also called neutron-activation logs; a record of radiation from radionuclides that are produced in the vicinity of a well by irradiation with neutrons; the short half-life radioisotopes usually are identified by the energy of their gamma radiation or decay time.

A electrode
One of the current-emitting electrodes of a resistivity-logging system (A); the current return electrode is labelled B.

Analog recording
Data are represented as a continuous record of physical variables instead of discrete values, as in digital recording.

Annulus
The space between the drill pipe or casing and the wall of the drill hole; in rocks saturated with hydrocarbons, the annulus is the transition interval between the invaded zone and the uncontaminated zone.

API unit
The American Petroleum Institute (API) has established test pits for calibrating neutron and gamma logs. The API neutron unit is defined as 1/1,000 of the difference between electrical zero and the logged value opposite the Indiana limestone in the calibration pit that has an average porosity of 19 percent. The API gamma unit is defined as 1/200 of the deflection between intervals of high and low radioactivity in the calibration pit.

Apparent resistivity
Resistivity on a log that deviates from the true value, because of the effects of the borehole, invaded zone, or other extraneous effects (Ra); the term “apparent” also is used for other logs that might need correction to provide true values.

Atomic number (Z)
The number of protons in the nucleus of an atom equal to the number of electrons in a neutral atom.

Atomic weight
The total number of protons and neutrons in the nucleus of an atom.

Back-up curve
A curve on the analog record that displays log data on a new scale when deflections on the main curve exceed the width of the paper; usually displayed with a different pattern or color.

Bottom-hole temperature
The bottom-hole temperature (BHT) usually is measured with maximum recording thermometers attached to a logging probe.

Borehole-compensated
Probes designed to reduce the extraneous effects of the borehole and of probe position are called borehole-compensated.

Borehole television or video
A downhole television camera; see acoustic-televiewer definition.

Bulk density
Bulk density is the mass of material per unit volume; in logging, it is the density, in grams per cubic centimeter, of the rock with pore volume filled with fluid.

Calibration
Determination of the log values that correspond to environmental units, such as porosity or bulk density; calibration usually is carried out in pits or by comparison with laboratory analyses of core.

Caliper log
A continuous record of hole diameter, usually made with a mechanical probe having from one to six arms.

Casing-collar locator
An electromagnetic device (CCL) that usually is run with other logs to record the location of collars or other changes in casing or pipe.

Cementation factor
The cementation exponent (m) in Archies' equation relating formation-resistivity factor and porosity; cementation factor as relates to many aspects of pore and grain geometry that affect permeability.

Cement bond log
An acoustic amplitude log that is used to determine the location of cement behind the casing and, under some conditions, the quality of the bonding to casing and rock.

Centralizer
A device designed to maintain a probe in the center of a borehole.

Collimation
The technique for forcing radiation, like gamma photons, into a beam.

Compressional wave
Compressional acoustic waves (P) are propagated in the same direction as particle displacement; they are faster than shear waves and are used for measuring acoustic velocity or transit time.

Compton scattering
The inelastic scattering of gamma photons by orbital electrons; Compton scattering is related to electron density and is a significant process in gamma-gamma (density) logging.

Correlation
Determination of the position of stratigraphically equivalent rock units in different wells, often done by matching the character of geophysical logs; also the matching of variables, such as log response and core analyses.

Crossplot
A term used in log analysis for a plot of one parameter versus another, usually two different types of logs. Useful for the identification of lithology.

Curie
The quantity of any radionuclide that produces 3.70×10^{10} disintegrations per second.

Cycle skip
In acoustic-velocity logging, cycle skips are caused by only one of a pair of receivers being triggered by an arriving wave, which causes sharp deflections on the log.

Dead time
In nuclear logging, dead time is the amount of time required for the system to be ready to count the next pulse; pulses occurring during dead time are not counted.

Decay
In nuclear physics, the process of disintegration of an unstable radioisotope by the spontaneous emission of charged particles or photons.

Decentralize
Forcing a logging probe against one side of the drill hole.

Density log
Also called gamma-gamma log; gamma photons from a radioactive source in the sonde are backscattered to a detector; the backscattering is related to the bulk density of the material around the sonde.

Departure curves
Graphs that show the correction that may be made to logs for some extraneous effects, such as hole diameter, bed thickness, temperature, etc.

Depth reference or datum
Zero reference for logs of a well; kelly bushing may be used if the rig is still on the well; ground level or top of casing is frequently used.

Depth of invasion
Radial distance from the wall of the hole to which mud filtrate has invaded.

Depth of investigation
See volume of investigation, also called radius or diameter of investigation.

Detector
Can be any kind of a sensor used to detect a form of energy, but usually refers to nuclear detectors, such as scintillation crystals.

Deviation
The departure in degrees between the drill hole or probe axis and vertical.

Differential log
A log that records the rate of change of some logged value as a function of depth; the differential log is sensitive to very small changes in absolute value.

Digital log
A log recorded as a series of discrete numerical values; (compare analog recording).

Dipmeter
A multielectrode, contact-resistivity probe that provides data from which the strike and dip of bedding can be determined.

Directional survey
A log that provides data on the azimuth and deviation of a borehole from the vertical.

Dual laterolog
A focused resistivity log with both shallow and deep investigation; usually gamma, SP, and microfocused logs are run simultaneously.

Effective porosity
Interconnected pore space that contributes to permeability.

Electric log
Generic term usually referring to the resistivity log that consists of long normal, short normal, lateral, and SP curves, but also used for other types of resistivity logs.

Electromagnetic-casing inspection log
The effects of eddy currents on a magnetic field are used to provide a record of the thickness of the casing wall.

Electron volt
The energy acquired by an electron passing through a potential difference of one volt (eV); used for measuring the energy of nuclear radiation and particles, usually expressed as million electron volts (MeV).

Epithermal neutron
A neutron source emits fast neutrons that are slowed by moderation to an energy level just above thermal equilibrium, where they are available for capture; most modern neutron probes measure epithermal neutrons, because they are less affected by chemical composition than thermal neutrons.

Field print
A copy of a log obtained at the time of logging that has not been edited or corrected.

First reading
The depth at which logging began at the bottom of the hole.

Flowmeter
A logging device designed to measure the rate, and usually the direction, of fluid movement in a well; most are designed to measure vertical flow.

Fluid sampler
An electronically controlled device that can be run on a logging cable to take water samples at selected depths in the well.

Flushed zone
The zone in the borehole wall behind the mudcake that is considered to have had all mobile native fluids flushed from it.

Focused log
A resistivity log that employs electrodes designed to focus the current into a sheet that provides greater penetration and vertical resolution than unfocused logs.

Formation
Used in well-logging literature in a general sense to refer to all material penetrated by a drill hole without regard to its lithology or structure; used in a stratigraphic sense, formation refers to a named body of rock strata with unifying lithologic features.

Formation-resistivity factor
Formation factor (F) is the ratio of the electrical resistivity of a rock 100 percent saturated with water (R_o) to the resistivity of the water with which it is saturated (R_w): $F = R_o/R_w$.

Gamma log
Also called gamma-ray log or natural-gamma log; log of the natural radioactivity of the rocks penetrated by a drill hole; also will detect gamma-emitting artificial radioisotopes (see spectral-gamma log).

Gamma ray
A photon that has neither mass nor electrical charge that is emitted by the nucleus of an atom; measured in gamma logging and output from a source used in gamma-gamma logging.

Grain density
Also called matrix density; the density of a unit volume of rock matrix at zero porosity, in grams per cubic centimeter.

Ground electrode
A surface electrode used for SP and resistivity logging.

Guard log
A type of focused resistivity log that derives its name from guard electrodes that are designed to focus the flow of current.

Half-life
The time required for a radioisotope to lose one half of its radioactivity from decay.

Induction log
A method for measuring resistivity or conductivity that uses an electromagnetic technique to induce a flow of current in the rocks around a borehole; can be used in nonconductive-borehole fluids.

Interval transit time
The time required for a compressional acoustic wave to travel a unit distance (t); transit time usually is measured by acoustic or sonic logs, in microseconds per foot, and is the reciprocal of velocity.

Invaded zone
The annular interval of material around a drill hole where drilling fluid has replaced all or part of the native interstitial fluids.

Isotopes
Atoms of the same element that have the same atomic number, but a different mass number; unstable isotopes are radioactive and decay to become stable isotopes.

Lag
The distance a nuclear logging probe moves during one time constant.

Last reading
The depth of the shallowest value recorded on a log.

Lateral log
A multielectrode, resistivity-logging technique that has a much greater radius of investigation than the normal techniques, but requires thick beds and produces an unsymmetrical curve.

Laterolog
A focused-resistivity logging technique; see also guard log.

Long normal log
A resistivity log with AM spacing usually 64 in.; see normal logs.

Matrix
The solid framework of rock or mineral grains that surrounds the pore spaces.

M electrode
The potential electrode nearest to the A electrode in a resistivity device.

Mho
A unit of electrical conductance that is the reciprocal of ohm.

Microresistivity log
Refers to a group of short-spaced resistivity logs that are used to make measurements of the mud cake and invaded zone.

Mud cake
Also called filter cake; the layer of mud particles that builds up on the wall of a rotary-drilled hole as mud filtrate is lost to the formation.

Mud filtrate
The liquid effluent of drilling mud that penetrates the wall of the hole.

N electrode
The potential electrode distant from the A electrode in a resistivity device.

Neutron
An elementary particle of the nucleus of an atom that has the same mass as a proton (1) but no charge; a neutron source is required to make neutron logs.

Neutron log
Neutrons from an isotopic source are measured at one or several detectors after they migrate through material in, and adjacent to, the borehole. Log response primarily results from hydrogen content, but it can be related to saturated porosity and moisture content.

Noise
A general term used for spurious or erratic log response not related to the property being logged; noise logs use an

acoustic receiver to detect sound caused by rapid fluid movement in the hole.

Normal log
A quantitative-resistivity log, made with four electrodes, that employs spacings between 4 and 64 in. to investigate different volumes of material around the borehole; see also long-normal log and short-normal log.

Nuclear log
Well logs using nuclear reactions either measuring response to radiation from sources in the probe or measuring natural radioactivity present in the rocks.

Ohm (Ω)
The unit of electrical resistance through which 1 amp of current will flow when the potential difference is 1 V.

Ohm-meter (Ωm)
Unit of electrical resistivity; the resistivity of 1 m^3 of material, which has a resistance of 1 ohm when electrical current flows between opposite faces; the standard unit of measurement for resistivity logs.

Open hole
Uncased intervals of a drill hole.

Porosity
The ratio of the void volume of a porous rock to the total volume, usually expressed as a percentage.

Probe
Also called sonde or tool; downhole well-logging instrument package.

Proton
The nucleus of a hydrogen atom; a positively charged nuclear particle with a mass of one; see neutron.

Radioactivity
Energy emitted as particles or rays during the decay of an unstable isotope to a stable isotope.

Repeat section
A short interval of log that is run a second time to establish repeatability and stability.

Resistivity logs
Any of a large group of logs that are designed to make quantitative measurements of the specific resistance of a material to the flow of electric current; calibrated in ohm-meters.

Reversal
A typical distortion of normal-resistivity logs opposite beds that are thinner than the AM spacing; the effect is an apparent decrease in resistivity in the center of a resistive unit.

Rugosity
The irregularity or roughness of the wall of a borehole.

Saturation
The percentage of the pore space occupied by a fluid, usually water in hydrologic applications.

Scintillation detector
An efficient detector used in nuclear-logging equipment; radiation causes flashes of light that are amplified and output in a crystal as electronic pulses by a photomultiplier tube to which it is coupled.

Secondary porosity
Porosity developed in a rock after its deposition as a result of fracturing or solution; usually not uniformly distributed.

Shale base line
A line drawn through the SP log deflections that represent shale; a similar technique can be used on gamma logs and can represent the average log response of sand.

Shear wave
An acoustic wave with direction of propagation at right angles to the direction of particle vibration (S wave).

Short-normal log
One of a group of normal-resistivity logs usually with AM spacing of 16 in. or less.

Single-point resistance log
A single electrode device used to make measurements of resistance that cannot be used quantitatively.

Spacing
The distance between sources or transmitters and detectors or receivers on a logging probe.

Spectral-gamma log
A log of gamma radiation as a function of its energy that permits the identification of the radioisotopes present.

Spine and ribs plot
A plot of long-spaced detector output versus short-spaced

detector output for a dual detector gamma-gamma probe; permits correction for some extraneous effects.

Spinner survey
A log made with an impeller flowmeter.

Spontaneous-potential log
A log of the difference in DC voltage between an electrode in a well and one at the surface; most of the voltage results from electrochemical potentials that develop between dissimilar borehole and formation fluids.

Standoff
Distance separating a probe from the wall of a borehole.

Survey
Oil-industry term used for the performance or result of a well-logging operation.

Temperature log
A log of the temperature of the fluids in the borehole; a differential temperature log records the rate of change in temperature with depth and is sensitive to very small changes.

Thermal neutron
A neutron that is in equilibrium with the surrounding medium such that it will not change energy (average 0.025 eV) until it is captured.

Time constant
The time in seconds required for an analog system to record 63 percent of the change that actually occurred from one signal level to another.

Tracer log
Also called tracejector log; a log made for the purpose of measuring fluid movement in a well by means of following a tracer injected into the well bore; tracers can be radioactive or chemical.

Track
Term used for the areas in the American Petroleum Institute log grid that are standard for most large well-logging companies; track 1 is to the left of the depth column, and tracks 2 and 3 are to the right of the depth column, but are not separated.

Transducer
Any device that converts an input signal to an output signal of a different form; it can be a transmitter or receiver in a logging probe.

Variable-density log (VDL)
Also called 3-dimensional log; a log of the acoustic wave train that is recorded photographically, so that variations in darkness are related to the relative amplitude of the waves.

Z/A effect
Ratio of the atomic number (Z) to the atomic weight (A), which affects the relation between the response of gamma-gamma logs and bulk density.